CLAIMS

We claim:

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1. A radio frequency transponder, comprising:

an antenna for receiving an interrogation signal;

a memory that stores an information code; and

a phase modulator coupled to the antenna and memory, the phase modulator being structured to produce a backscatter response signal by phase modulating the interrogation signal according to the information code.

2. The transponder of claim 1 wherein the phase modulator includes:

a switch having a control terminal and first and second conduction terminals, the first conduction terminal being coupled to the antenna;

a quarter-wavelength stub coupled to the second conduction terminal of the switch; and

a driver coupled between the memory and the control terminal of the switch, the driver being structured to produce a modulating signal corresponding to the information code, the modulating signal alternately opening and closing the switch.

3. The transponder of claim 2 wherein the driver includes a microprocessor.

4. The transponder of claim 1 wherein the phase modulator includes a diode coupled to the antenna and a driver coupled between the memory and the diode, the driver being structured to produce a modulating signal corresponding to the information code, the modulating signal being a variable voltage that modulates a capacitance of the diode to phase modulate the interrogation signal and thereby produce the response signal.

5. The transponder of claim 4 wherein the driver includes a microprocessor.

6. The transponder of claim 1 wherein the phase modulator includes:

a first diode having first and second ends, the second end being coupled to the antenna;

a second diode having first and second ends, the first end being coupled to the antenna and the second end of the first diode;

a quarter-wavelength stub coupled to the second end of the second diode;

a parallel RC circuit coupled between the stub and a reference voltage; and

a driver coupled between the memory and the first end of the first diode, the driver being structured to produce a modulating signal corresponding to the information code.

7. The transponder of claim 1 wherein the phase modulator is structured to include in the response signal a plurality of phases in addition to a phase that is substantially identical to a phase of the interrogation signal.

8. The transponder of claim 1 wherein the phase modulator includes first and second phase changers that produce in the response signal respective first and second phases that are each different than a phase of the interrogation signal.

9. The transponder of claim 8 wherein the phase modulator further includes a third phase changer that produces in the response signal a third phase that is different than the phase of the interrogation signal, each of the phase changers include a switch coupled between the antenna and a stub having a length other than a wavelength of the interrogation signal.

10. A radio frequency communication system, comprising:

an interrogator that transmits a radio frequency interrogation signal and receives a backscatter response signal; and

a transponder that receives the interrogation signal and transmits the response signal to the interrogator, the transponder including:

a memory that stores an information code; and

a phase modulator coupled to the memory and structured to produce the response signal by phase modulating the interrogation signal according to the information code.

11. The communication system of claim 10 wherein the transponder includes an antenna that receives the interrogation signal and transmits the response signal and the phase modulator includes:

a quarter-wavelength stub;

a switch coupled between the stub and the antenna and having a control terminal; and

a driver coupled between the memory and the control terminal of the switch, the driver being structured to produce a modulating signal corresponding to the information code, the modulating signal alternately opening and closing the switch.

12. The communication system of claim 10 wherein the transponder includes an antenna that receives the interrogation signal and transmits the response signal and the phase modulator includes a diode coupled to the antenna and a driver coupled between the memory and the diode, the driver being structured to produce a modulating signal corresponding to the information code, the modulating signal being a variable voltage that modulates an impedance of the diode to phase modulate the interrogation signal and thereby produce the response signal.

13. The communication system of claim 10 wherein the transponder includes an antenna that receives the interrogation signal and transmits the response signal and the phase modulator includes:

a first diode having first and second ends, the second end being coupled to the antenna;

a second diode having first and second ends, the first end being coupled to the antenna and the second end of the first diode;

a quarter-wavelength stub coupled to the second end of the second diode;

a parallel RC circuit coupled between the stub and a reference voltage; and

a driver coupled between the memory and the first end of the first diode, the driver being structured to produce a modulating signal corresponding to the information code.

14. The communication system of claim 10 wherein the phase modulator is structured to include in the response signal a plurality of phases in addition to a phase that is substantially identical to a phase of the interrogation signal.

15. The communication system of claim 10 wherein the phase modulator includes first and second phase changers that produce in the response signal respective first and second phases that are each different than a phase of the interrogation signal.

16. The communication system of claim 15 wherein the transponder includes an antenna that receives the interrogation signal and transmits the response signal and the phase modulator further includes a third phase changer that produces in the response signal a third phase that is different than the phase of the interrogation signal, each of the phase changers include a switch coupled between the antenna and a stub having a length other than a wavelength of the interrogation signal.

Sub A4

17. A radio frequency transponder, comprising:

means for receiving a radio frequency interrogation signal from an interrogator;

means for phase modulating the interrogation signal according to an information code to produce a response signal; and

means for transmitting the response signal.

18. The transponder of claim 17 wherein the phase modulating means include:

stub means having a length other than a wavelength of the interrogation signal;

a switch coupled to the stub means and having a control terminal; and

signal producing means for producing a modulating signal corresponding to the information code, the modulating signal being applied to the control terminal of the switch to alternately open and close the switch.

19. The transponder of claim 18 wherein the signal producing means include a memory that stores the information code and processing means coupled to the memory, the processing means being for producing the modulating signal as a function of the information code.

20. The transponder of claim 17 wherein the phase modulating means include diode means and driver means for producing and applying to the diode means a modulating signal corresponding to the information code, the modulating signal being a variable voltage that modulates an impedance of the diode means to phase modulate the interrogation signal and thereby produce the response signal.

Sub B1

21. The transponder of claim 20 wherein the signal producing means include a memory that stores the information code and processing means coupled to the

memory, the processing means being for producing the modulating signal as a function of the information code.

22. The transponder of claim 20 wherein the phase modulating means include:

a first diode coupled to the transmitting means;

a second diode coupled to the antenna and the first diode;

a quarter-wavelength stub coupled to the second diode;

a parallel RC circuit coupled between the stub and a reference voltage; and

driver coupled to the first diode, the driver means being for producing and applying to the first diode a modulating signal corresponding to the information code.

23. The transponder of claim 17 wherein the phase modulating means include first and second phase changers that produce in the response signal respective first and second phases that are each different than a phase of the interrogation signal.

24. The transponder of claim 23 wherein the phase modulating means further include a third phase changer that produces in the response signal a third phase that is different than the phase of the interrogation signal, each of the phase changers including a switch coupled between the antenna and a stub having a length other than a wavelength of the interrogation signal.

25. A method of radio frequency communication, the method comprising:

receiving a radio frequency interrogation signal from an interrogator;

phase modulating the interrogation signal according to an information code to produce a response signal; and

transmitting the response signal.

26. The method of claim 25 wherein the phase modulating step includes:

alternately opening and closing a switch according to a modulating signal corresponding to the information code, the switch being coupled between an antenna that transmits the response signal and a stub that has a length other than a wavelength of the interrogation signal.

27. The method of claim 25 wherein the phase modulating step includes producing a modulating signal corresponding to the information code, the modulating signal being a variable voltage that modulates a capacitance of a diode to phase modulate the interrogation signal and thereby produce the response signal.

28. The method of claim 25 wherein the phase modulating step includes producing in the response signal a plurality of phases that are each different than a phase of the interrogation signal.

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